

NxPCM Assessment for Mobility

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Study Title: “Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction After Long-Duration Space Flight” (E120; Mobility)

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Research Gaps

- Gaps associated with this study:
 - **SM1:** “What is the relationship between the mode of in-flight exercise and post-flight sensorimotor performance?”
 - **SM2:** “What is the time course of recovery of sensorimotor function after long duration spaceflight?”
- **Recommended future studies or gap(s):**
 - This study contributed knowledge to gap **SM1**, but does not warrant closure of the gap at this time. The PIs and NxPCM suggest if possible an additional study using an US/Russian in-flight exercise data sharing agreement to further evaluate the relationship between current in-flight exercise and post-flight functional mobility.
 - The Mobility study provided information for gap **SM2** and lead to the initiation of the Functional Task Test. These data in combination with current ground based studies are expected to provide the information needed to determine the risks associated with sensorimotor changes to recover functional mobility and dynamic visual acuity and provide information to update flight standards. No additional studies are recommended at this time. Based on study outcome, inform medical operations of the recommendation to add a flight visual performance test for dynamic visual acuity to post-flight neurological exams.

NxPCM Study Summary:

The Mobility study compared the pre-flight versus post-flight performance of eighteen ISS crewmembers. The crewmembers consisted of 1 female and 17 males; 15 had previous space flight experience with an age range of 37 to 54. Locomotor function was evaluated by two tests, the Integrated Treadmill Locomotion Test (ITLT) and the Functional Mobility Test (FMT). The results determined that all crewmembers exhibited altered locomotor function after long duration space flight as indicated by an “average increase in the time to complete the FMT course by 62% on one day after landing compared with their respective pre-flight performance”. In addition, this investigation determined post-flight recovery is composed of “two distinct, but interrelated motor learning processes: rapid on-line strategic change characterized by immediate onset after landing and slower adaptive change requiring days to complete after landing”. Current ground based studies are underway to develop adaptability training programs that may provide an inexpensive

countermeasure that would require little to no extra crew time for gait and manual control issues and minimize the recovery time. This study also determined the average time for functional mobility testing and dynamic visual acuity to return to pre-flight levels was 11 days post return. The Functional Task Test (FTT) and current ground studies will provide additional data and the needed information to fill the knowledge gap SM2.

The relationship of in-flight exercise and post-flight Sensorimotor function was evaluated using data collected in conjunction with interim Resistive Exercise Device (iRED), Treadmill Vibration Isolation System (TVIS) and Cycle Ergometer Vibration Isolation System (CEVIS) exercises. The study determined that “subjects who performed squat exercises on the iRED with greater loads had enhanced post-flight (R+1) functional mobility performance”. They speculated that this could be attributed to the use of postural muscles to perform the squat exercise. The investigators recommend future studies to identify relationships with other in-flight exercise methods and an agreement be made to share US/Russian in-flight exercise data to increase the number of subjects and strengthen correlations.

The investigators also recommend the addition of a flight visual performance test for dynamic visual acuity be added to post-flight neurological exams.